Clean Water Act §319(h) Nonpoint Source Grant Program

Development of the Upper Llano River Watershed Protection Plan
TSSWCB Project #11-04

Quality Assurance Project Plan – Water Quality Monitoring
Revision 1

Texas State Soil and Water Conservation Board

prepared by
Texas AgriLife Research,
Texas Water Resources Institute
and
Texas Tech University,
Llano River Field Station

Effective Period: Upon EPA approval through October 2014
(with Annual Updates Required)

Questions concerning this quality assurance project plan should be directed to:

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-or-
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Section A1: Title and Approval Sheet

Water Quality Monitoring Quality Assurance Project Plan for *Development of the Upper Llano River Watershed Protection Plan.*

<u>United States Environmental Protection Agency (EPA), Region VI</u>

Name: Curry Jones
Title: EPA Chief State/Tribal Programs Section

Signature: ________________________________ Date:____________________

Name: Henry Brewer
Title: EPA Texas Nonpoint Source Project Officer

Signature: ________________________________ Date:____________________

<u>Texas State Soil and Water Conservation Board (TSSWCB)</u>

Name: Jana Lloyd
Title: TSSWCB Project Manager (PM)

Signature:____________________________________Date:______________

Name: Pamela Casebolt
Title: TSSWCB Quality Assurance Officer (QAO)

Signature:____________________________________Date:______________

<u>Texas AgriLife Research, Texas Water Resources Institute (TWRI)</u>

Name: Kevin Wagner, PhD
Title: TWRI Project Lead

Signature:____________________________________Date:______________

Name: Lucas Gregory
Title: TWRI QAO

Signature:____________________________________Date:______________

Texas Tech University, Llano River Field Station (TTU-LRFS)

Name: Tom Arsuffi, PhD
Title: Director; Project Co-Lead

Signature:_________________________________Date:____________

Name: Emily Seldomridge, PhD
Title: TTU-LRFS QAO

Signature:_________________________________Date:____________

Texas State University, Edwards Aquifer Research & Data Center (EARDC)

Name: Joe Guerrero
Title: EARDC Lab Manager (LM)

Signature:_________________________________Date:____________

Section A2: Table of Contents

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List of Acronyms and Abbreviations

CAR	Corrective action report
CD	Compact Disc
COC	Chain of custody
CWA	Clean Water Act
DOQQS	Digital ortho quarter quads
DQO	Data quality objectives
DTED	Digital terrain elevation data
EARDC	Edwards Aquifer Research and Data Center
EPA	United States Environmental Protection Agency
ESRI	Environmental Systems Research Institute
GIS	Geographic information system
GPS	Global positioning system
GSD	Ground sample distance
LRFS	Llano River Field Station
LULC	Land use / land cover
NAD	North American Datum
NAIP	National Agriculture Imagery Program
NDOP	National Digital Orthophoto Program
NELAP	National Environmental Laboratory Accreditation Program
NLCD	USGS national land cover data set
PM	Project Manager
QA	Quality assurance
QC	Quality control
QAO	Quality Assurance Officer
QAPP	Quality assurance project plan
QM	Quality manual
SLWA	South Llano Watershed Alliance
SOP	Standard operating procedures
SWQMIS	Surface Water Quality Monitoring Information System
SSL	Spatial Sciences Laboratory
SWAT	Surface water assessment tool
TCEQ	Texas Commission on Environmental Quality
TM	Landsat Thematic Mapper
TMDL	Total maximum daily load
TNI	The National Environmental Lab. Accreditation Conference Institute
TSSWCB	Texas State Soil and Water Conservation Board
TTU	Texas Tech University
TWRI	Texas Water Resources Institute
USDA-NRCS	U.S. Department of Agriculture-Natural Resources Conservation Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WPP	Watershed Protection Plan

Section A3: Distribution List

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

United States Environmental Protection Agency, Region VI (EPA)

6WQ-AT
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Name: Curry Jones
Title: USEPA Chief State/Tribal Programs Section

Name: Henry Brewer
Title: USEPA Texas Nonpoint Source Project Officer

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Name: Kevin Wagner
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Name: Emily Seldomridge
Title: TTU-LRFS QAO

Texas State University, Edwards Aquifer Research & Data Center (EARDC)

248 Freeman Aquatic Building
San Marcos, TX 78666

Name: Joe Guerrero
Title: EARDC Lab Manager

Section A4: Project/Task Organization

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

EPA – United States Environmental Protection Agency, Region VI, Dallas, Texas. Provides project oversight and funding at the federal level.

Henry Brewer, EPA Texas Nonpoint Source Project Officer

Responsible for overall performance and direction of the project at the federal level. Ensures that the project assists in achieving the goals of the Clean Water Act (CWA). Reviews and approves the QAPP, project progress, and deliverables.

TSSWCB –Texas State Soil and Water Conservation Board, Temple, Texas. Provides project overview at the State level.

Jana Lloyd, TSSWCB PM

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Reviews and approves Quality Assurance Project Plan (QAPP) and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants.

Pamela Casebolt; TSSWCB QAO

Reviews and approves QAPP and any amendments or revisions. Responsible for verifying that the QAPP is followed by project participants. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures. Determines that the project meets the requirements for planning, quality assessment, quality control (QC), and reporting under the CWA §319(h) NPS Grant Program.

TWRI - Texas AgriLife Research, Texas Water Resources Institute, College Station, Texas. Responsible for reporting and development of data quality objectives (DQOs) and a (QAPP).

Kevin Wagner, Project Lead

The TWRI Project Lead is responsible for ensuring that tasks, reporting, and other requirements in the contract are executed on time and with the quality assurance/quality control requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; and submitting accurate and timely deliverables to the TSSWCB PM.

Lucas Gregory, QAO

Responsible for determining that the QAPP meets the requirements for planning, quality control, and quality assessment. Conducts audits of field and laboratory systems and procedures as needed. Responsible for maintaining the official, approved QAPP, as well as conducting Quality Assurance (QA) audits in conjunction with TSSWCB personnel.

TTU-LRFS - Texas Tech University, Llano River Field Station, Junction, Texas. Responsible for characterizing current water quality and biological conditions throughout the Upper Llano River watershed for use in WPP development.

<u>Tom Arsuffi, TTU-LRFS Director; Project Co-Lead</u>

Responsible for coordinating and supervising field sampling activities. Responsible for ensuring that field personnel have adequate training, equipment, and a thorough knowledge of standard operation procedures (SOPs) specific to the analysis or task performed and/or supervised. Responsible for ensuring that tasks and other requirements in the contract are executed on time and within the QA/QC requirements in the system as defined by the contract workplan and in the QAPP. Responsible for verifying that the data produced are of known and acceptable quality.

<u>Emily Seldomridge, TTU-LRFS QAO</u>

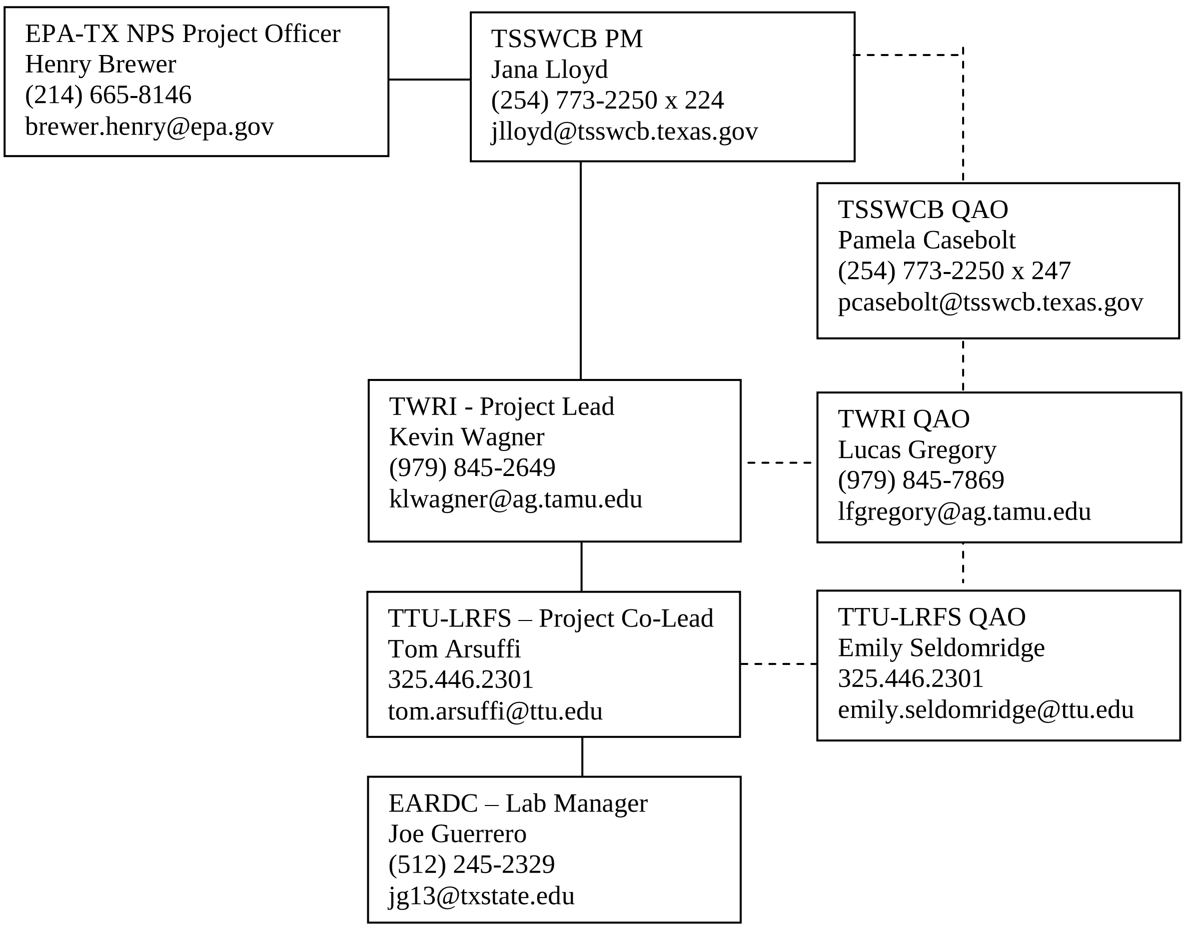
Responsible for project reporting and determining that the QAPP meets the requirements for planning, quality control, and quality assessment. Conducts audits of field and laboratory systems and procedures. Responsible for maintaining the official, approved QAPP, as well as conducting QA audits on behalf of TTU-LRFS, and in conjunction with TSSWCB personnel.

EARDC - Texas State University, Edwards Aquifer Research & Data Center, San Marcos, Texas. Responsible for characterizing current water quality and biological conditions throughout the Upper Llano River watershed for use in WPP development.

<u>Joe Guerrero, EARDC Lab Manager</u>

Responsible for ensuring that all samples received in the EARDC Laboratory are within the allotted time, and that the chain of custody (COC) has been observed. Ensures that the samples are analyzed in accordance with standard accepted methods as described in the SOP manual. The Laboratory Manager further ensures that all analysis results are correctly performed and properly recorded on the lab data sheets and in the appropriate analytical log books prior to transmittal to the QAO. Also responsible for ensuring that the EARDC Laboratory conforms to approved analysis methods and ensuring that analysis results are transmitted to TTU-LRFS in an efficient and timely manner. Responsible for identifying, and maintaining Laboratory QA records. Coordinates and monitors deficiencies, nonconformances, and corrective action for sample analysis conducted at the EARDC laboratory. Coordinates and maintains records of data verification and validation at the EARDC laboratory.

Figure A4.1 Project Organization Chart



Section A5: Problem Definition/Background

The South Llano River is a true gem of the Texas Hill Country. Its spring-fed flows are legendary. The South Llano River is important in that during periods of low rainfall and minimal surface runoff, spring flow from the underlying aquifers is paramount in maintaining surface flows. The river and springs that feed it support several unique plant and animal communities, and provide constant critical flows downstream to the Llano and Colorado Rivers and Lake LBJ, especially during times of drought. Stream flow data collected by USGS during the summer of 2006 showed that flow of the spring-fed Llano River accounted for roughly 75% of the water flowing into the Highland Lakes, which support Austin and other downstream Colorado River users. Limited data is available on the water quality, quantity, hydrological or biotic conditions of the North Llano River. Although located in a similar geomorphological and climatological region, it differs from the South Llano River in that much of its flows are derived from surface runoff. Because of these various factors, data collection and analysis of the North and South Llano River Watershed is warranted.

Due to the pristine nature and relatively constant flow of the springs, the South Llano River is currently a healthy ecosystem supporting a variety of aquatic and terrestrial ecosystems, as well as numerous recreational opportunities. It is the only major watershed containing a genetically pure population of Guadalupe Bass, the Texas State Fish. The South Llano River is recognized by the Texas Parks and Wildlife Department as an Ecologically Significant Stream having high water quality, exceptional aquatic life, high aesthetic value, and diverse benthic macroinvertebrate and fish communities (Bayer et al., 1992; Linam et al., 1999). Further, during the early to mid-1980s, the South Llano River was designated by TCEQ as a least disturbed ecoregion reference stream for Ecoregion 30. As such, the South Llano River represents a benchmark for which other streams are assessed throughout the ecoregion for water quality standards development and use attainment decisions. The TCEQ Surface Water Quality Monitoring Program (SWQM) is currently conducting a project to further develop and refine the methods and techniques to evaluate the condition of aquatic communities in streams throughout Texas based on these least disturbed streams. TCEQ will be revisiting the South Llano River as part of this effort. Significant and relevant findings from this TCEQ study will be incorporated into the WPP as appropriate.

According to “Land of the Living Waters: A Characterization of the South Llano River, Its Springs, and Its Watershed” prepared by the Environmental Defense Fund, the primary threat to the South Llano River is loss of spring flow. Over the past century, one third of the major spring systems of Texas have ceased flowing largely due to aquifer withdrawals. However, subtle changes due to land fragmentation, loss of riparian habitat, and encroachment of juniper species on upland habitats also have the potential to decrease the water quality and quantity of the river.

Additionally, there is potential for increased biological pollution and reduction in flows should what are now isolated pockets of invasive plants continue to spread. These plants, giant reed (*Arundo donax*) and elephant ears (*Colocasia esculenta*) are emergent hydrophytes and use vast quantities of water relative to native riparian communities. According to the EPA, more than one third of all the States have waters that are listed for invasive species under the §303(d) section of the CWA. Physical and biological disruptions of aquatic systems caused by invasive species alter water quantity and water quality. Invasive species have a variety of negative impacts on water resources affecting recreation, irrigation, municipal, and agricultural water supply. These invasive species affect the quantity and timing of runoff, erosion, sedimentation, and other natural physical processes and may affect water availability in general. Comprehensive analyses and evaluations of these processes will provide critical evaluation tools to managers and policy makers on how best to factor invasive species into water management plans. It is far less expensive to address invasive species issues proactively than reactively. To proactively address incipient invasive species issues in the Upper Llano River Watershed, guidance from EPA's Office of Wetlands, Oceans and Watersheds Invasive Species Action Plan to improve effectiveness at countering invasive species that adversely impact the nation's aquatic systems will be used, in particular, monitoring, education and outreach and rapid response elements.

The protection and preservation of the Upper Llano River and its springs is an environmental, economic, and cultural concern. This was recognized by the local community, and in 2009 the South Llano Watershed Alliance (SLWA) was organized as a 501(c)(3) non-governmental organization. The SLWA is an organization of landowners and interested stakeholders whose mission is to preserve and enhance the South Llano River and adjoining watersheds by encouraging land and water stewardship through collaboration, education, and community participation (http://southllano.org/). This group is thought to be the only proactively formed stakeholder group in Texas organized to ensure flows and water quality are maintained for future generations. The group also provides a forum for natural resource management education, discussion, and coordination of efforts to address other identified land and water management issues that may impact the long-term viability of the resource.

Working with SLWA and other local and regional stakeholders, a WPP will be developed to protect and maintain the ecological integrity of this important waterbody from threats arising from land fragmentation, noxious woody vegetation, aquatic invasive species, groundwater availability, and the potential for groundwater exports and aquifer contamination. To the extent possible, the EPA Healthy Watersheds Initiative concepts, assessments, and management approaches outlined in the technical guidance document "Identifying and Protecting Healthy Watersheds" (EPA 2011) will be used to help guide the assessment and planning process.

Section A6: Project/Task Description

Targeted monitoring and analysis of historic data will be employed as defined in Subtask 5.6, led by TTU-LRFS to assess ecological conditions, invasive species populations, bank erosion, and other indicators of watershed condition. This will be conducted to support watershed planning and provide needed information for a thorough assessment of the Upper Llano watershed.

TTU-LRFS will conduct routine ambient monitoring at 14 mainstem sites and tributaries quarterly, collecting field parameters, conventional parameters, and flow (Subtask 5.1). The sampling period extends over 30 months. The number of samples planned for collection is 140. Currently, routine ambient monitoring is conducted quarterly at 2 stations by LCRA and TCEQ (16701 and 17425) through the Clean Rivers Program. Sampling will be coordinated with these entities to prevent duplication of efforts and ensure comparability.

Flow data will be collected as defined (Subtask 5.1) by Doppler, and flow severity will be noted. Field parameters measured will include pH, temperature, conductivity, and dissolved oxygen. Conventional parameters measured will include total suspended solids, turbidity, sulfate, chloride, nitrate nitrogen, ammonia nitrogen, total kjeldahl nitrogen, chlorophyll a, pheophytin, total hardness, total phosphorus and E. coli (enumerated using SM 9223B). The EARDC at Texas State University, a NELAP accredited laboratory, will conduct sample analysis, provide all containers and chain of custody. The purpose of this QAPP is to clearly delineate the QA policy, management structure, and procedures, which will be used to implement the QA requirements necessary to assess ecological conditions, invasive species populations, bank erosion, and other indicators of watershed condition to support watershed planning in the Upper Llano watershed.

TTU-LRFS will conduct biological monitoring (fish, macroinvertebrate, and habitat assessment; Subtask 5.2) at 14 locations twice a year for 2 years to assess the cumulative impact of pollutant loading on stream health and biological communities of stream health. Biotic conditions and assessments for main stem and lower portions of the watersheds are just beginning as part of the Guadalupe Bass Restoration Project for the South Llano River with TPWD in conjunction with TTU-LRFS and Texas State University.

TTU-LRFS will conduct spring sampling at 6 sites including 700 Springs, Big Paint and Tanner Springs. Quarterly field, conventional, and flow parameters will be collected. Water quality parameters to be measured are defined in Subtask 5.1. The sampling period extends over 30 months. The number of samples planned for collection is 60. The EARDC, a NELAP accredited laboratory, will conduct sample analysis and provide all containers and chain of custody.

TTU-LRFS will conduct surveys and map distribution and abundance of invasive emergent and aquatic plants from the headwaters (Llano Springs, 700 Springs, South Llano River and North Llano River) to Junction (Subtask 5.4). TTU-LRFS and ESSM will work with the TPWD Aquatic Habitat Enhancement Program Director to determine BMPs for controlling or eradicating invasive species and develop an invasive species management plan for incorporation into the WPP.

TTU-LRFS will conduct surveys and map the distribution, abundance, and severity of cut and eroding banks on the South and North Llano Rivers (Subtask 5.5).

TTU-LRFS will conduct a historical data review for the waterbody, to be included in the WPP, in order to assess and characterize trends and variability in water quality (Subtask 5.6). Historical data collection activities will concentrate on 1) ambient water quality data (including groundwater); 2) stream flow and water level data; 3) precipitation records; and 4) biological data. U.S. Geological Survey, National Weather Service, TPWD, Texas Water Development Board, GCDs, LCRA, TCEQ, EPA and others will be queried for data related to the study area.

Through TSSWCB project 05-02 FY05 Statewide NPS Pollution Management Project, USGS installed and is operating a real-time streamflow gage on the South Llano River at Flat Rock Lane at Junction, TX (USGS 08149900). Through this project, TTU-LRFS will work with USGS to provide operation and maintenance for this new real-time streamflow gage (Subtask 5.7). Continuous sampling extends over 36 months. This gaging station will complement the existing gages maintained by the USGS. The USGS maintains real-time gages at 08150000 Llano River near Junction and 08148500 North Llano River near Junction. Until May 31, 2012, USGS also collected periodic data at gages 08149500 Seven Hundred Springs near Telegraph and 08149400 South Llano River near Telegraph. TTU-LRFS will work with USGS to ensure continued operation of the real-time USGS gages throughout the duration of the project.

TTU-LRFS will transfer monitoring data from activities in Subtask 5.1-5.3 and 5.7 to TSSWCB for inclusion in the TCEQ Surface Water Quality Monitoring Information System (SWQMIS) at least quarterly (Subtask 5.8). Data will be transferred in the correct format using the TCEQ file structure, along with a completed Data Summary, as described in the most recent version of TCEQ Surface Water Quality Monitoring Data Management Reference Guide.

TWRI will submit Station Location Requests to TCEQ, as needed, to obtain TCEQ station numbers for new monitoring sites. TWRI will input monitoring regime into the TCEQ Coordinated Monitoring Schedule. Data Correction Request Forms will be submitted to TSSWCB whenever errors are discovered in data already reported. All monitoring data files, Data Summary, and Data Correction Request Forms will also be provided to LCRA. TTU-LRFS will post monitoring data from activities in Task 5 to the project website in a timely manner.

TTU-LRFS, with assistance by TWRI, will incorporate the watershed assessment findings in the WPP (Subtask 5.9).

Table A6.1. Project Plan Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
1.1	Provide updates for quarterly progress reports	TTU-LRFS/ TWRI	Nov 11	Aug 14
1.3	Participate in coordination meetings or conference calls with project partners, at least quarterly	TTU-LRFS/ TWRI	Nov 11	Aug 14
2.1	Develop QAPP for Task 5 Water Quality Monitoring	TTU-LRFS/ TWRI	Nov 11	Sept 12
2.2	Provide revisions and necessary amendments to the QAPP	TTU-LRFS/ TWRI	Aug 12	Aug 14
5.1	Conduct quarterly monitoring at 14 stream sites	TTU-LRFS	Sept 12	Sept 14
5.2	Conduct semi-annual biological monitoring at 14 stream sites	TTU-LRFS	Sept 12	Sept 14
5.3	Conduct quarterly monitoring at 6 spring sites	TTU-LRFS	Sept 12	Sept 14
5.4	Conduct surveys to map invasive plants	TTU-LRFS	Sept 12	Nov 13
5.5	Conduct surveys to map eroding banks	TTU-LRFS	Sept12	Nov 13
5.6	Conduct historical water quality, flow, precip, & ecological data review	TTU-LRFS	Nov 11	Nov 12
5.7	Work with USGS to ensure operation of streamflow gage	TTU-LRFS	Nov 11	Aug 14
5.8	Transfer monitoring data to TCEQ SWQMIS quarterly	TTU-LRFS	Sept 12	Aug 14
5.9	Incorporate findings in the watershed protection plan	TTU-LRFS	Nov 13	Aug 14

Section A7: Data Quality Objectives and Criteria

The objective of this project is to provide sufficient data to characterize current water quality and biological conditions throughout the Upper Llano River watershed as needed for development of a WPP. Measurement performance specifications to support this objective are specified in Tables A7.1 and A7.2. Data analyses and interpretation will be conducted as follows: 1) water quality data will analyzed using statistical analyses and used in combination with flow data to determine flow duration curves and load assesments; 2) macroinvertebrate data will be used as indicators of water quality, and will be analyzed using CADDIS, graphical analyses, and Rapid Biological Assesment indices; 3) fish data will be used as indicators of water quality, and will be analyzed using the Index of Biotic Integrity and 4) maps of the distribution of invasive plants and cut banks will help better target needed restoration activities. The Upper Llano River is a healthy ecosystem with few point sources and watershed planning activities will address potential nonpoint source loading, as well as issues with invasive plants and erosion from cutbanks.

Table A7.1 Measurement performance specifications for field water quality parameters measured in the water column by TTU-LRFS personnel.

Parameter (Units)	Method	Parameter Code	AWRL	LOQ	LOQ Check Sample %Rec	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS
Temperature, Water (^{o}C)	SM 2550 B & TCEQ SOP V1	00010	NA*	NA	NA	NA	NA
Flow Stream, Instantaneous (cfs)	TCEQ SOP V1	00061	NA*	NA	NA	NA	NA
Specific Conductance, Field (uSs/cm @ 25C)	EPA 120.1 & TCEQ SOP, V1	00094	NA*	NA	NA	NA	NA
Oxygen, Dissolved (mg/L)	SM 4500-O G & TCEQ SOP, V1	00300	NA*	NA	NA	NA	NA
pH (Standard Units)	EPA 150.1 & TCEQ SOP, V1	00400	NA*	NA	NA	NA	NA
Flow Severity:1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry	TCEQ SOP V1	01351	NA*	NA	NA	NA	NA
Stream Flow Estimate (cfs)	TCEQ SOP, V1	74069	NA*	NA	NA	NA	NA
Flow Mth 1=Gage 2=Elec 3=Mech 4=Weir/Flu 5=Doppl	TCEQ SOP V1	89835	NA*	NA	NA	NA	NA

* Reporting to be consistent with SWQM guidance and based on measurement capability.

References:

United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes, Manual #EPA-600/4-79-020

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 (RG-415).

Table A7.2 Measurement performance specifications for conventional water quality parameters analyzed by EARDC.

Parameter (Units)	Method	Parameter Code	AWRL	LOQ	LOQ Check Sample %Rec	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS
Residue, Total Nonfiltrable (mg/L)	SM 2540 D	00530	4	2.5***	NA	NA	NA
Nitrogen, Ammonia, Total (mg/L as N)	EPA 350.1 Rev. 2.0 (1993)	00610	0.1	0.4	70-130	20	80-120
Nitrate + Nitrite Nitrogen, Total (mg/L as N)	EPA 353.2 Rev. 2.0 (1993)	00620	0.05	0.06	70-130	20	80-120
Nitrogen, Kjeldahl, Total (mg/L as N)	EPA 351.2 Rev. 2.0 (1993)	00625	0.2	0.4	70-130	20	80-120
Phosphorus, Total, Wet Method (mg/L as P)	SM 4500-P E	00665	0.06	0.05	70-130	20	80-120
Hardness, Total (mg/L as $CaCO_3$)	SM 2340 C	00900	5	10	NA	20	80-120
Chloride (mg/L as Cl)	EPA 300.0 Rev. 2.1 (1993)	00940	5	1	70-130	20	80-120
Sulfate (mg/L as SO_4)	EPA 300.0, Rev. 2.1 (1993)	00945	5	5	70-130	20	80-120
Chlorophyll-A, Fluorometric Method, ug/L	SM 10200H	70953	3	1***	NA	20	80-120
E. coli, MPN Enumeration, MPN/100 mL**	SM 9223B	31648	1	1***	NA	0.50*	NA
Pheophytin-A ug/L Fluorometric Method	SM 10200H	32213	3	1***	NA	NA	NA
Turbidity, Lab Nephelometric Turbidity Units, NTU	EPA 180.1 Rev. 2.0 (1993)	82079	0.5	0.06	NA	NA	NA

* This value is not expressed as a relative percent difference.It represents the maximum allowable difference between the logarithm of the result of a sample and the logarithm of the duplicate result.See Section B5.

** *E.coli* samples should always be processed as soon as possible and within 8 hours for compliance purposes and within 24 hours for non-regulatory purposes.

***MDL not LOQ.

References:

United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes, Manual #EPA-600/4-79-020

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Table A7.3 Measurement performance specifications for biological-benthics (quantitative).

Parameter (Units)	Matrix	Method	Parameter Code	Lab
Benthic Data Reporting Units (1=Number of Individuals In Sub-Sample, 2=Number Of Individuals/ft^2, 3=Number Of Individuals/m^2, 4=Total Number Of Individuals In Sample)	Other	TCEQ SOP, V2	89899	TU
Hess sampler effort, area sampled (m^2)	Other	Barbour et al., 1999	pending	TU
Benthic Sample Collection Method (1=Surber, 2=Ekman, 3=Kicknet, 4=Peterson, 5=Hester Dendy, 6=Snag)	Other	TCEQ SOP, V2	89950	TU
Area Of Snag Surface Sampled (m^2)	Other	TCEQ SOP, V2	89975	TU
Undercut Bank At Collection Point (%)	Other	TCEQ SOP, V2	89921	TU
Overhanging Brush At Collection Point (%)	Other	TCEQ SOP, V2	89922	TU
Gravel Bottom At Collection Point (%)	Sediment	TCEQ SOP, V2	89923	TU
Sand Bottom At Collection Point (%)	Sediment	TCEQ SOP, V2	89924	TU
Soft Bottom At Collection Point (%)	Sediment	TCEQ SOP, V2	89925	TU
Macrophyte Bed At Collection Point (%)	Other	TCEQ SOP, V2	89926	TU
Snags And Brush At Collection Point (%)	Other	TCEQ SOP, V2	89927	TU
Bedrock Streambed At Collection Point (%)	Sediment	TCEQ SOP, V2	89928	TU
Benthos Organisms -None Present	Other	TCEQ SOP, V2	90005	TU
Mesh Size, Any Net Or Sieve, Average Bar (cm)	Other	TCEQ SOP, V2	89946	TU
Stream Order	Water	TCEQ SOP, V1	84161	TU
Ecoregion Level III (Texas Ecoregion Code)	Other	TCEQ SOP, V1	89961	TU
Total Taxa Richness, Benthos	Other	TCEQ SOP, V2	90055	TU
Number Of Diptera Taxa	Other	TCEQ SOP, V2	90056	TU
Number Of Ephemeroptera Taxa	Other	TCEQ SOP, V2	90057	TU
Total Number Of Intolerant Taxa, Benthos	Other	TCEQ SOP, V2	90058	TU
Ept, Percent Of Individuals	Other	TCEQ SOP, V2	90060	TU
Chironomidae, Percent Of Individuals	Other	TCEQ SOP, V2	90062	TU
Tolerant Benthos, Percent Of Individuals	Other	TCEQ SOP, V2	90066	TU
Benthic Grazers, Percent Of Individuals	Other	TCEQ SOP, V2	90020	TU
Benthic Gatherers, Percent Of Individuals	Other	TCEQ SOP, V2	90025	TU
Benthic Filterers, Percent Of Individuals	Other	TCEQ SOP, V2	90030	TU
Dominant 3 Taxa, Percent Of Individuals	Other	TCEQ SOP, V2	90067	TU

References:
Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.
TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 (RG-415).
TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416)

Table A7.4 Measurement Performance Specifications for Biological-Benthics (Qualitative)

Parameter (Units)	Matrix	Method	Parameter Code	Lab
Stream order	Water	TCEQ SOP, V1	84161	TU
Ecoregion level III (Texas ecoregion code)	Other	TCEQ SOP, V1	89961	TU
Benthic data reporting units (1=# of individuals in sub-sample, 2=# of individuals/ft^2, 3=# of individuals/m^2, 4=total # of individuals in sample)	Other	TCEQ SOP, V2	89899	TU
Dip net effort,area swept (m^2)	Other	TCEQ SOP, V2	89902	TU
Kicknet effort,area kicked (m^2)	Other	TCEQ SOP, V2	89903	TU
Kicknet effort,minutes kicked (min.)	Other	TCEQ SOP, V2	89904	TU
Debris/shoreline sampling effort (min.)	Other	TCEQ SOP, V2	89905	TU
Number of individuals in benthic sample	Other	TCEQ SOP, V2	89906	TU
Benthic collection method (1=Surber, 2=Ekman, 3=Kicknet, 4=Peterson, 5=Hester Dendy, 6=Snag)	Other	TCEQ SOP, V2	89950	TU
Hess sampler effort, area sampled (m^2)	Other	Barber et al., 1999	pending	TU
Undercut bank at collection point (%)	Other	TCEQ SOP, V2	89921	TU
Overhanging brush at collection point (%)	Other	TCEQ SOP, V2	89922	TU
Gravel bottom at collection point (%)	Sediment	TCEQ SOP, V2	89923	TU
Sand bottom at collection point (%)	Sediment	TCEQ SOP, V2	89924	TU
Soft bottom at collection point (%)	Sediment	TCEQ SOP, V2	89925	TU
Macrophyte bed at collection point (%)	Other	TCEQ SOP, V2	89926	TU
Snags and brush at collection point (%)	Other	TCEQ SOP, V2	89927	TU
Bedrock streambed at collection point (%)	Sediment	TCEQ SOP, V2	89928	TU
Petersen sampler effort, area sampled (m^2)	Other	TCEQ SOP, V2	89934	TU
Ekman sampler effort, area sampled (m^2)	Other	TCEQ SOP, V2	89935	TU
Mesh size, any net or sieve, average bar (cm)	Other	TCEQ SOP, V2	89946	TU
Total taxa richness, benthos	Other	TCEQ SOP, V2	90055	TU
Benthos organisms-none present	Other	TCEQ SOP, V2	90005	TU
Hilsenhoff biotic index (HBI)	Other	TCEQ SOP, V2	90007	TU
Number of EPT index	Other	TCEQ SOP, V2	90008	TU
Chironomidae, percent of individuals	Other	TCEQ SOP, V2	90062	TU
Dominant taxon, benthos percent of individuals	Other	TCEQ SOP, V2	90042	TU
Dominant functional feeding group, % of individual	Other	TCEQ SOP, V2	90010	TU
Benthic predators, percent of individuals	Other	TCEQ SOP, V2	90036	TU
Ratio of intolerant to tolerant taxa, benthos	Other	TCEQ SOP, V2	90050	TU
% of *trichoptera* individuals as *hydropsychidae*	Other	TCEQ SOP, V2	90069	TU
Number of non-insect taxa	Other	TCEQ SOP, V2	90052	TU
Benthic gatherers, percent of individuals	Other	TCEQ SOP, V2	90025	TU
Elmidae, percent of individuals	Other	TCEQ SOP, V2	90054	TU

References:

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 (RG-415).

TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416)

Table A7.5 Measurement Performance Specifications For Biological-Nekton

Parameter (Units)	Matrix	Method	Parameter Code	Lab
Stream order	Water	TCEQ SOP, V1	84161	TU
Seine, minimum mesh size, average bar, nekton (in)	Other	TCEQ SOP, V2	89930	TU
Seine, maximum mesh size, avg bar, nekton,inch	Other	TCEQ SOP, V2	89931	TU
Net length (m)	Other	TCEQ SOP, V2	89941	TU
Electrofishing method 1=boat 2=backpack 3=totebarge	Other	TCEQ SOP, V2	89943	TU
Electrofish effort, duration of shocking (sec)	Other	TCEQ SOP, V2	89944	TU
Seining effort (# of seine hauls)	Other	TCEQ SOP, V2	89947	TU
Combined length of seine hauls (m)	Other	TCEQ SOP, V2	89948	TU
Seining effort, duration (min)	Other	TCEQ SOP, V2	89949	TU
Ecoregion level III (texas ecoregion code)	Other	TCEQ SOP, V1	89961	TU
Area seined (m^2)	Other	TCEQ SOP, V2	89976	TU
Number of species, fish	Other	TCEQ SOP, V2	98003	TU
Nekton organisms-none present	Other	TCEQ SOP, V2	98005	TU
Total number of sunfish species	Other	TCEQ SOP, V2	98008	TU
Total number of intolerant species, fish	Other	TCEQ SOP, V2	98010	TU
Percent of individuals as omnivores, fish	Other	TCEQ SOP, V2	98017	TU
Percent of individuals as invertivores, fish	Other	TCEQ SOP, V2	98021	TU
Percent of individuals as piscivores, fish	Other	TCEQ SOP, V2	98022	TU
Percent of individuals with disease or anomaly	Other	TCEQ SOP, V2	98030	TU
Total number of native cyprinid species	Other	TCEQ SOP, V2	98032	TU
Percent individuals as non-native fish species (% of community)	Other	TCEQ SOP, V2	98033	TU
Total number of individuals seining	Other	TCEQ SOP, V2	98039	TU
Total number of individuals electrofishing	Other	TCEQ SOP, V2	98040	TU
Total number of benthic invertivore species	Other	TCEQ SOP, V2	98052	TU
Total number of benthic fish species	Other	TCEQ SOP, V2	98053	TU
Number of individuals per seine haul	Other	TCEQ SOP, V2	98062	TU
Number of individuals per minute electrofishing	Other	TCEQ SOP, V2	98069	TU
Percent individuals as tolerant fish species(excluding western mosquitofish)	Other	TCEQ SOP, V2	98070	TU

References:

TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 (RG-415).

TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416)

Table A7.6 Measurement performance specifications for biological-habitat.

Parameter	Matrix	Method	Parameter Code	Lab
Flow, stream, instantaneous (cubic feet per sec)	Water	TCEQ SOP, V2	00061	TU
Streambed slope (ft/ft)	Other	TCEQ SOP, V2	72052	TU
Average percentage instream cover	Other	TCEQ SOP, V2	84159	TU
Stream order	Water	TCEQ SOP, V2	84161	TU
Number of lateral transects made	Other	TCEQ SOP, V2	89832	TU
Flow metod (1=gage 2=elec 3=mech 4=weir/flu 5=doppl)	Other	TCEQ SOP, V2	89835	TU
Total number of stream bends	Other	TCEQ SOP, V2	89839	TU
Number of well defined stream bends	Other	TCEQ SOP, V2	89840	TU
Number of moderately defined stream bends	Other	TCEQ SOP, V2	89841	TU
Number of poorly defined stream bends	Other	TCEQ SOP, V2	89842	TU
Total number of riffles	Other	TCEQ SOP, V2	89843	TU
Dominant substrate type (1=clay, 2=silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other)	Sediment	TCEQ SOP, V2	89844	TU
Average percent of substrate gravel size or larger	Other	TCEQ SOP, V2	89845	TU
Average stream bank erosion (%)	Other	TCEQ SOP, V2	89846	TU
Average stream bank slope (degrees)	Other	TCEQ SOP, V2	89847	TU
Habitat flow status, 1=no flow, 2=low,3=mod,4=hi	Other	TCEQ SOP, V2	89848	TU
Average percent trees as riparian vegetation	Other	TCEQ SOP, V2	89849	TU
Average percent shrubs as riparian vegetation	Other	TCEQ SOP, V2	89850	TU
Average percent grass as riparian vegetation	Other	TCEQ SOP, V2	89851	TU
Average % cultivated fields as riparian vegetation	Other	TCEQ SOP, V2	89852	TU
Average percent other as riparian vegetation	Other	TCEQ SOP, V2	89853	TU
Average percentage of tree canopy coverage	Other	TCEQ SOP, V2	89854	TU
Drainage area above downstream transect (km^2)*	Other	TCEQ SOP, V2	89859	TU
Length of stream evaluated (km)	Other	TCEQ SOP, V2	89860	TU
Average stream width (m)	Other	TCEQ SOP, V2	89861	TU
Average stream depth (m)	Other	TCEQ SOP, V2	89862	TU
Maximum pool width at time of study (m)	Other	TCEQ SOP, V2	89864	TU
Maximum pool depth at time of study (m)	Other	TCEQ SOP, V2	89865	TU
Average width of natural riparian vegetation (m)	Other	TCEQ SOP, V2	89866	TU
Aesthetics of reach (1=wild 2=nat. 3=comm. 4=off.)	Other	TCEQ SOP, V2	89867	TU
Number of stream cover types	Other	TCEQ SOP, V2	89929	TU
Ecoregion level III (Texas ecoregion code)	Other	TCEQ SOP, V2	89961	TU
Land develop impact (1=unimp, 2=low, 3=mod, 4=high)	Other	TCEQ SOP, V2	89962	TU

* From USGS Map

References:

TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416)

Ambient Water Reporting Limits (AWRLs)

The AWRL establishes the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Tables A7.1 and A7.2 are the project-defined reporting specifications for each analyte and yield data acceptable for the water quality assessment. The limit of quantitation (LOQ) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The following requirements must be met in order to report results to the TSSWCB:

- The laboratory's LOQ for each analyte must routinely be at or below the AWRL.
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check sample for each analytical batch of samples analyzed.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water) or sample/duplicate pairs in the case of bacterial analysis. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Tables A7.1 and A7.2.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control samples and LOQ check samples prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for bias are specified in Tables A7.1 and A7.2.

Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. The extensive data collection at 14 mainstem and tributary sites and 6 springs on a quarterly basis for 2 years will ensure the water quality assessment is spatially and temporally representative of routine water quality conditions. Water quality data are collected on a routine frequency and are separated by approximately even time intervals. At a minimum, aquatic habitat, benthic, and nekton samples are collected over at least two seasons (to include inter-seasonal variation) and over two years (to include inter-year variation) and include some data collected during an index period (March 15- October 15). Although data may be collected during varying regimes of weather and flow, the data sets will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the water body will be tempered by the potential funding for complete representativeness.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in TCEQ SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in the Data Management Plan Section B10.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

Section A8: Special Training/Certification

New field personnel receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the QAO (or designee) their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Field personnel training is documented and retained in the personnel file and will be available during a monitoring systems audit.

The requirements for Global Positioning System (GPS) certification are located in Section B10, Data Management.

The EARDC is a NELAP Accredited Laboratory and meets the requirements contained in section TNI Volume 1 Module 2, Section 4.5.5.

Section A9: Documentation and Records

The documents and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table A9.1.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention (yr)	Format
QAPPs, amendments and appendices	TWRI	5	Paper/Electronic
Field SOPs	TTU-LRFS	5	Paper/Electronic
Laboratory Quality Manuals	EARDC	5	Paper/Electronic
Laboratory SOPs	EARDC	5	Paper/Electronic
QAPP distribution documentation	TWRI	5	Paper/Electronic
Field staff training records	TTU-LRFS	5	Paper/Electronic
Field equipment calibration/maintenance logs	TTU-LRFS	5	Paper/Electronic
Field instrument printouts	TTU-LRFS	5	Paper/Electronic
Field notebooks or data sheets	TTU-LRFS	5	Paper/Electronic
Chain of custody records	TTU-LRFS	5	Paper/Electronic
Laboratory calibration records	EARDC	5	Paper/Electronic
Laboratory instrument printouts	EARDC	5	Paper/Electronic
Laboratory data reports/results	TTU-LRFS/ EARDC	5	Paper/Electronic
Laboratory equipment maintenance logs	EARDC	5	Paper/Electronic
Corrective Action Documentation	TWRI	5	Paper/Electronic

Quarterly progress reports will note activities conducted in connection with the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. Corrective Action Reports (CARs) will be utilized when necessary. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP. All quarterly progress reports and QAPP revisions will be distributed to personnel listed in Section A3. A blank CAR form is presented in Appendix A and a blank Chain of Custody (COC) form is presented in Appendix C. The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

Laboratory Test Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the TNI Volume 1, Module 2, Section 5.10 and include the information necessary for the interpretation and validation of data. At a minimum, test reports (regardless of whether they are hard copy or electronic) should include the following:

- Sample results
- Units of measurement
- Sample matrix
- Dry weight or wet weight (as applicable)

- Station information
- Date and time of collection
- Sample depth
- Holding time for SM9223-B
- LOQ and LOD (formerly referred to as the reporting limit and the method detection limit, respectively), and qualification of results outside the working range (if applicable)
- Certification of NELAP compliance

Electronic Data

At a minimum, all pertinent electronic data files will be backed up monthly on an external hard drive and stored in separate area away from the computer. All electronic files will be archived to CD upon completion of the project, and then stored with the final report for 5 years. Data will be submitted electronically to the TSSWCB project manager for inclusion in the TCEQ SWQMIS. A completed Data Summary (see Appendix D), as described in the current version of the *Surface Water Quality Monitoring Data Management Reference Guide* (http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wdma/dmrg_index.html), will be submitted with each data submittal.

QAPP Revision and Amendments

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised versions have been fully approved; the revision must be submitted to the TSSWCB for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This will be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

QAPP amendments may be necessary to reflect changes in project organization, tasks, schedules, objectives and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Written requests for amendments are directed from the TWRI Project Lead to the TSSWCB PM and are effective immediately upon approval by the TSSWCB PM and QAO. Amendments to the QAPP and the reasons for the changes will be documented and distributed to all individuals on the QAPP distribution list by the TWRI Project Lead or designee. Amendments shall be reviewed, approved, and incorporated into the next revision of the QAPP.

Section B1: Collection Process/Field Survey Design

Sample Design Rationale

The purpose of the monitoring is to characterize the water quality and stream health in the Upper Llano River basin for development of a watershed protection plan and provide needed data for modeling activities. All data taken are considered critical to achieving these objectives.

Site Selection Criteria

This data collection effort involves monitoring routine water quality, using procedures that are consistent with the TCEQ SWQM program, for the purpose of data entry into the SWQMIS database maintained by the TCEQ. To this end, some general guidelines were followed when selecting sampling sites, as basically outlined below, and discussed thoroughly in the TCEQ *Surface Water Quality Monitoring Procedures*, *Volume 1* (RG-415). Overall consideration was given to accessibility and safety. Sites were selected considering the following:

1. Allows samples to be safely collected from the centroid of flow (i.e. midpoint of stream width which contains 50% of the total flow).
2. Best represents the water body, and not an unusual condition or contaminant source, backwater areas or eddies.
3. Maximizes stream/basin coverage, represents no more than 25 miles, and captures major hydrological features (e.g. confluence of a major tributary or instream dam).
4. Because historical water quality data can be very useful in assessing the watershed, existing monitoring sites were used where possible. Nine sites in the study area had previously been monitored by the TCEQ, USGS and/or Clean Rivers Program Partners. These formed the basis for the monitoring program.
5. All classified segments had at least one monitoring site.
6. Where possible, sources of pollution, influence of tributaries, changes in land uses, and hydrological modifications were bracketed.
7. Accessibility
8. Have a USGS stream flow gauge or conducive for flow measurement during routine visits.

Monitoring Sites

Based on the selection criteria described above, the monitoring sites in Table B1.1 and Figure B1.1 were identified.

Sampling Regime

The sampling program is designed to characterize water quality conditions under routine flow conditions and will not target any biased flow events. Samples will be collected quarterly for a 30 month period therefore characterizing water quality under varying flow regimes is expected. Sampling types and frequencies are described in Table B1.1. Physical parameters that will be measured *in situ* during routine sampling and include flow (cfs), specific conductance, DO, pH, and water temperature; other noted items will include the flow severity, and present weather conditions. Water quality samples collected as part of the routine sampling schedule will be analyzed in the lab for parameters as outlined in Table A7.2.

In order to obtain representative results, ambient water sampling will occur on a routine quarterly schedule over the course of 30 months, capturing dry and runoff-influenced events at their natural frequency. There will be no prejudice against rainfall or high flow events, except that the safety of the sampling crew will not be compromised in case of lightning or flooding; this is left up to the discretion of the sampling crew.

In the instance that a sampling (Table B1.1) site is inaccessible, no sample will be taken and will be documented in the field notebook. If, near the end of the study, the TSSWCB PM/QAO agrees that the sampling has not achieved good representativeness of typical conditions, the final sampling event(s) may be restricted to target a particular environmental condition (e.g., rainfall).

Table B1.1 Annual Sample Design and Schedule

Site Description (map ref. #)	Station ID	SE	CE	MT	Numer of sampling events scheduled annually umber							
					AqHab	Benthics	Nekton	Conv	Bacteria	Flow	Field	
North Llano River Sites												
N. Llano upstrream of Llano R. (01)	17425	TX	TU	RT	2	2	2	4	4	4	4	Coord. wit USGS Gag Lat 30.492
Bear Creek @ 1674 Bridge (02)	12212	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.520
N. Llano @ CR 274 (03)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.49
N. Llano @ CR 275 (04)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.490
N.Llano @ CR 271 (05)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.305
N. Llano @ CR 260 (06)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.498
N. Llano @ Richardson Ranch (07)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.479
N. Llano @ River Road below Fort Tarrett Reservoir (08)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.482
South Llano River Sites												
S. Llano @ State Park (09)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.453
S. Llano @ CR 150/Hwy 377 (10)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.393
S. Llano @ 1st Crossing/Hwy 377 (11)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.35
S. Llano @ Telegraph (12)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.319
S. Llano @ CR408 (14)	16701	TX	TU	RT	2	2	2	4	4	4	4	Sampling c Lat 30.241
Big Paint Creek (13)	TBD	TX	TU	RT	2	2	2	4	4	4	4	Lat 30.304
Springs												
Bois D'Arc Springs-NLR(S 01)	TBD	TX	TU	RT				4	4	4	4	Lat 30.462
Christmas Spring(S 02)	TBD	TX	TU	RT				4	4	4	4	Lat 30.319
Seven Hundred Springs-SLR (S	TBD	TX	TU	RT				4	4	4	4	USGS Gag

03)												Lat 30.270
Tanner Springs-SLR (S 04)	TBD	TX	TU	RT				4	4	4	4	Lat 30.259
Deats Spring- SLR(S 05)	TBD	TX	TU	RT				4	4	4	4	Lat 30.255
Llano Springs-SLR (S 06)	TBD	TX	TU	RT				4	4	4	4	Lat 30.223

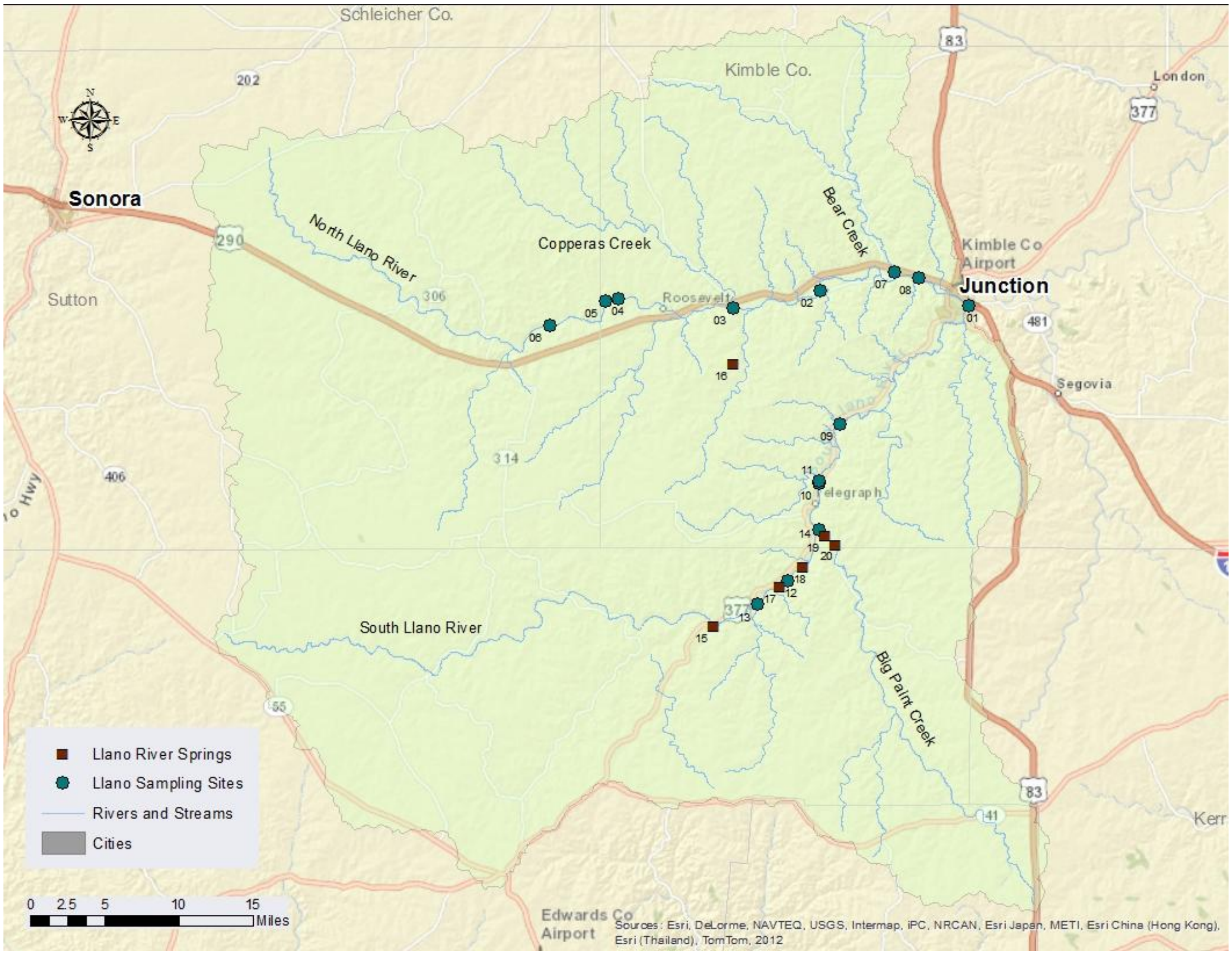
SE: Submitting Entity: party responsible for submitting data to TCEQ for inclusion in SWQMIS. In this case, TX = Texas State Soil and Water Conservation Board

CE: Collecting Entity: party responsible for collecting data that will be included in SWQMIS. In this case, TU = Llano River Field Station

MT: Monitoring Type: denotes the type of monitoring that will be done. In this case, RT = routine monitoring that is conducted on a set schedule and is not targeted toward a specific flow condition.

TBD: Station IDs will be requested and designated after TCEQ completed required paperwork. Until this occurs, fields will be noted with TBD.

Figure B1.1 Upper Llano monitoring sites (see Table B1.1 for site descriptions for each site ref. #).



Section B2: Data Collection Methods

Field Sampling Procedures

Field sampling will be conducted according to procedures documented in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012.(RG-415)* and *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data (RG-416)*. Additional aspects outlined in Table B2.1 below provide specific requirements for sampling and/or additional clarification.

Table B2.1 Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation	Temp	Sample Volume	Hold Time
Residue, Total Nonfiltrable (mg/L)	water	PC HDPE	N/A	<6°C	1000 mL	7 d
Nitrogen, Ammonia, Total (mg/L as N)	water	PC HDPE	Acidify w/ H_2SO_4 to pH 2	<6°C	250 mL	28 d
Nitrate + Nitrite Nitrogen, Total (mg/L as N)	water	PC HDPE	Acidify w/ H_2SO_4 to pH 2	<6°C	250 mL	28 d
Nitrogen, Kjeldahl, Total (mg/L as N)	water	PC HDPE	Acidify w/ H_2SO_4 to pH 2	<6°C	250 mL	28 d
Phosphorus, Total, Wet Method (mg/L as P)	water	PC HDPE	Acidify w/ H_2SO_4 to pH 2	<6°C	250 mL	28 d
Hardness, Total (mg/L as $CaCO_3$)	water	PC HDPE	N/A	<6°C	250 mL	6 m
Chloride (mg/L as Cl)	water	PC HDPE	N/A	<6°C	100 mL	28 d
Sulfate (mg/L as SO_4)	water	PC HDPE	N/A	<6°C	100 mL	28 d
Chlorophyll-a, Fluorometric Method, ug/L	water	Amber G-bottles	N/A	<6°C	950 mL	Filter within 48 hrs/28 days at 0ºC
E. coli, MPN Enumeration, MPN/100 mL	water	PS-PSB w/ Na2S2O3	N/A	4°C	150 mL	6 hrs*
Pheophytin-a ug/L Fluorometric Method	water	Amber G-bottles	N/A	<6°C	950 mL	48 hrs
Turbidity, Lab Nephelometric Turbidity Units, NTU	water	PC HDPE	N/A	<6°C	250 mL	48 hrs

PS-PSB w Na2S2O3:SSB: pre-sterilized polystyrene bottle with sodium thiosulfate
PC HDPE: pre-cleaned high-density polyethylene
G-Glass
**E.coli* samples analyzed by SM 9223-B should always be processed as soon as possible and within 8 hours for compliance purposes and within 24 hours for non-regulatory purposes.

Typically, water samples will be collected directly from the stream (midway in the stream channel) into sterile wide-mouthed polypropylene bottles or bags. Water samples used for *E. coli* analysis will be collected in presterilized polystyrene bottles with sodium thiosulfate buffer. All sample containers will be labeled with the following information:

- Collection date
- Collection time
- Sample location
- Sampler's initials

Care will be exercised to avoid the surface microlayer of water, which may be enriched with bacteria and not representative of the water column. In cases where, for safety reasons, it is inadvisable to enter the stream bed, and boat access is not practical, staff will use a clean bucket and rope from a bridge to collect the samples from the stream. If a bucket is used, care will be taken to avoid contaminating the sample. Specifically, technicians must exert care to ensure that the bucket and rope do not come into contact with the bridge. The bucket must be thoroughly rinsed between stations. Buckets are also to be sanitized between sampling stations with a bleach- or isopropyl alcohol-soaked wipe. The first bucketful of water collected from a bridge is used to rinse the bucket. Rinse water is not returned to the stream, but is instead disposed of away from the sampling site to ensure that the collected sample will not be affected by the bleach or alcohol residual. Samples are collected from subsequent buckets of water. This type of sampling will be noted in the field records.

Water temperature, pH, specific conductivity, specific conductance, and DO will be measured and recorded *in situ* with a multiprobe whenever samples are collected. Flow is measured with an electronic flow meter as described in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 (RG-415)*. All field measurements will be conducted in accordance with the methods listed in Table A7.1. All samples will be transported in an iced container to the laboratory for analysis.

Processes to Prevent Contamination

Procedures outlined in the *TCEQ Surface Water Quality Monitoring Procedures* outline the necessary steps to prevent contamination of samples (e.g. direct collection into sample containers, when possible). Field QC samples (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets as presented in Appendix B. Flow worksheets, aquatic life use monitoring checklists, habitat assessment forms, field biological assessment forms, and surface water quality monitoring field data sheets are part of the field data record. The following will be recorded for all visits:

1. Station ID

2. Sampling Date
3. Location
4. Sampling depth
5. Sampling time
6. Sample collector's name/signature
7. Values for all field parameters
8. Detailed observational data, including:
    - water appearance
    - weather
    - biological activity
    - unusual odors
    - pertinent observations related to water quality or stream uses (e.g., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps, etc.)
    - watershed or instream activities (events impacting water quality, e.g., bridge construction, livestock watering upstream, etc.)
    - specific sample information
    - missing parameters (i.e., when a scheduled parameter(s) is not collected)

Mapping of Invasive Plants and Cutbanks

Reconnaisance surveys of invasive plants (e.g. elephant ear, arundo, salt cedar) and cutbanks will be conducted in floatable sections of the N. and S. Llano Rivers. Surveys will be conducted via canoe or kayak and locations will be documented using GPS. In field notebooks, the distribution, abundance, and severity of cut and eroding banks along with the locations, size, and type of invasive species infestations will be recorded.

Recording Data

All field and laboratory personnel follow the basic rules for recording information including: (1) writing legibly in indelible, waterproof ink with no modifications, write-overs or cross-outs; (2) correcting errors with a single line followed by an initial and date; and (3) closing-out incomplete pages with an initialed and dated diagonal line.

Failures in Sampling Methods Requirements and/or Deviations from Sample Design and Corrective Action

Examples of failures in sampling methods and/or deviations from sample design requirements include but are not limited to such things as sample container problems, sample site considerations, etc. Failures or deviations from the QAPP are documented on the field data reporting form and reported to the TTU-LRFS Director. The TTU-LRFS Director, in consultation with the TWRI Project Lead and QAO, will determine if the failure or deviation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB PM in a Corrective Action Report (CAR). The CAR documents: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented (see Appendix A). CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

Section B3: Sample Handling and Custody

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The Chain of Custody (COC) form is a record that documents the possession of the samples from the time of collection to receipt in the laboratory. The following information concerning the sample is recorded on the COC form (See Appendix C):

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used
6. Was the sample filtered
7. Analyses required
8. Name of collector
9. Custody transfer signatures and dates and time of transfer
10. Bill of lading (if applicable)

Sample Labeling

Samples from the field are labeled on the container with an indelible marker. Label information includes:

1. Site identification
2. Date and time of collection
3. Preservative added, if applicable
4. Indication of field-filtration (for metals) as applicable
5. Sample type (i.e., analysis(es)) to be performed

Sample Handling

Following collection, samples are placed on ice in an insulated cooler for transport to the laboratory. At the laboratory, samples are placed in a refrigerated cooler dedicated to sample storage. The Laboratory Supervisor has the responsibility to ensure that holding times are met with water samples. The holding time is documented on the COC. Any problems will be documented with a corrective action report.

Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with COC procedures as described in this QAPP are immediately reported to the TTU-LRFS Director. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The TTU-LRFS Director in consultation with the TWRI Project Lead and QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB PM in a CAR and submitted to TSSWCB PM along with the quarterly progress report.

Section B4: Analytical Methods

The analytical methods, associated matrices, and performing laboratories are discussed in Section A7. Procedures for laboratory analysis are in accordance with the most recently published edition of the book entitled *Standard Methods for the Examination of Water and Wastewater*, the *TCEQ Surface Water Quality Monitoring Procedures*, or approved *EPA Methods for Chemical Analysis of Water and Wastes*.

Laboratories collecting data under this QAPP are compliant with the TNI Standards. Copies of laboratory QMs and SOPs are available for review by the TSSWCB.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The reagent bottle is labeled in a way that will trace the reagent back to preparation.

Analytical Method Deficiencies and Corrective Actions

Deficiencies in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the EARDC Laboratory Manager. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TSSWCB. The nature and disposition of the problem is reported on the data report which is sent to the TTU-LRFS Director. This information will be included in the CAR and submited with the Progress Report which is sent to the TSSWCB Project Manager.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

Section B5: Quality Control

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the TCEQ *Surface Water Quality Monitoring Procedures, Volume I: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012* (RG-415*)*. Specific requirements are outlined below. Field QC sample results are submitted with the laboratory data report (see Section A9).

Field Split
A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the TCEQ *Surface Water Quality Monitoring Procedures, Volume I: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012* (RG-415*)*. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits apply to conventional samples only and are collected on a 10% basis. If less than ten samples are collected in a month, one set of field splits will be collected per month. To the extent possible, field splits prepared and analyzed over the course of the project will be performed on samples from different sites. The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

$$RPD = |(X1 - X2)/\{(X1+X2)/2\} * 100|$$

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the sample handling and analytical system. If it is determined that elevated quantities of analyte (i.e., > 5 times the LOQ) were measured and analytical variability can be eliminated as a factor, than variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some individual sample results may be invalidated based on the examination of all extenuating information. The information derived from field splits is generally considered to be event specific and would not normally be used to determine the validity of an entire batch; however, some batches of samples may be invalidated depending on the situation. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Summary. Deficiencies will be addressed as specified in this section under Quality Control or Acceptability Requirements Deficiencies and Corrective Actions.

Field blank
A field blank is a sample of analyte free water poured into the container in the field, preserved and shipped to the laboratory with field samples according to procedures specified in the TCEQ *Surface Water Quality Monitoring Procedures, Volume I: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2008* (RG-415*)*. Field blanks are used to assess contamination from sample collection, preservation, handling, and shipping. Field blanks apply

to conventional samples and are collected on a 10% basis. If less than ten samples are collected in a month, one set of field blanks will be collected per month. To the extent possible, field blanks prepared and analyzed over the course of the project will be performed on samples from different sites. The analysis of field blanks should yield values lower than the LOQ. When target analyte concentrations are high, blank values should be lower than 5% of the lowest value of the batch.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch
A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. **A** preparation batch is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 25 hours. An analytical batch is composed of prepared environmental samples (extract, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements
QC samples, other than those specified later this section, are run (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the laboratory QM. The minimum requirements that all participants abide by are stated below.

Limit of Quantitation (LOQ)
The laboratory will analyze a calibration standard (if applicable) at the LOQ published in Table A7.2 on each day calibrations are performed. In addition, an LOQ check sample will be analyzed with each analytical batch. Calibrations including the standard at the LOQ listed in Table A7.2 will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Sample
An LOQ check sample consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check sample is spiked into the sample matrix at a level less than or near the LOQ published in Table A7.2, for each analyte for each analytical batch of samples run. If it is

determined that samples have exceeded the high range of the calibration curve, samples should be diluted or run on another curve. For samples run on batches with calibration curves that do not include the LOQ published in Table A7.2, a check sample will be run at the low end of the calibration curve.

The LOQ check sample is carried through the complete preparation and analytical process. LOQ check samples are run at a rate of one per analytical batch. The percent recovery of the LOQ check sample is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check sample:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LOQ check sample analyses as specified in Table A7.2.

Laboratory Control Sample (LCS)

An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the mid point of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation batch. Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample. The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.2.

Laboratory Duplicates

A laboratory duplicate is an aliquot taken from the same container as an original sample under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per preparation batch.

For most parameters except bacteria, precision is evaluated using the relative percent difference (RPD) between duplicate LCS results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X1 and X2, the RPD is calculated from the following equation:

$$RPD = |(X1 - X2)/\{(X1+X2)/2\} * 100|$$

For bacteriological parameters, precision is evaluated using the results from laboratory duplicates. Bacteriological duplicates are collected on a 10% frequency (or once per sampling run, whichever is more frequent). These duplicates will be collected in sufficient volume (200 mL or more) for analysis of the sample and its laboratory duplicate from the same container. The base-10 logarithms of the result from the original sample and the result from its duplicate will be calculated. The absolute value of the difference between the two logarithms will be calculated, and that difference will be compared to the precision criterion in Table A7.2.

If the difference in logarithms is greater than the precision criterion, the data are not acceptable for use under this project and will not be reported. Results from all samples associated with that failed duplicate (usually a maximum of 10 samples) will be considered to have excessive analytical variability and will be qualified as not meeting project QC requirements.

The precision criterion in Table A7.2 for bacteriological duplicates applies only to samples with concentrations > 10 organisms/100mL. Field splits will not be collected for bacteriological analyses.

Matrix spike (MS)
Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes indicate the effect of the sample on the precision and accuracy of the results generated using the selected method. The frequency of matrix spikes is specified by the analytical method, or a minimum of one per preparation batch, whichever is greater. To the extent possible, matrix spikes prepared and analyzed over the course of the project should be performed on samples from different sites.

The components to be spiked shall be as specified by the mandated analytical method. The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix, and are expressed as percent recovery (%R). The percent recovery of the matrix spike is calculated using the following equation, where %R is percent recovery, SSR is the concentration measured in the matrix spike, SR is the concentration in the unspiked sample, and SA is the concentration of analyte that was added:

$$\%R = (SSR-SR)/SA*100$$

Matrix spike recoveries are compared to the acceptance criteria published in the mandated test method. If the matrix spike results are outside established criteria, the data for the analyte that failed in the parent sample is not acceptable for use under this project and will not be reported. The result from the parent sample associated with that failed matrix spike will be considered to have excessive analytical variability and will be qualified by the laboratory as not meeting project QC requirements.

Method blank
A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blanks are performed at a rate of once per preparation batch The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less then 5% of the lowest value of the batch, or corrective action will be implemented. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g. reprocessing or data qualifying codes). In all cases the corrective action must be documented.

The method blank shall be analyzed at a minimum of one per preparation batch. In those instances for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Quality Control or Acceptability Requirements Deficiencies and Corrective Actions

Sampling QC excursions are evaluated by the TTU-LRFS Director, in consultation with the TTU-LRFS QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the TTU-LRFS Director and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Notations of field split excursions are noted in the quarterly progress report, CARs, and the final Report.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and the nature and disposition of the problem is reported to the EARDC Laboratory Manager and QAO. The Laboratory Manager and QAO will discuss with the TTU-LRFS Director and QAO. If applicable, the TTU-LRFS Director will include this information in the CAR and submit with the quarterly progress report, which is sent to the TSSWCB PM.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

Section B6: Instrument/Equipment Testing, Inspection, and Maintenance

All sampling equipment testing and maintenance requirements are detailed in the *TCEQ Surface Water Quality Monitoring Procedures, Volume I: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012* (RG-415*)*. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QM(s).

GPS equipment testing will be accomplished by the GPS Operator prior to, during and after field use. Built-in equipment diagnostics and functionality checks will be utilized in accordance with the operation manuals. Results will be reported in pre-survey, field and post-processing logs. Issues will be documented with the GPS Coordinator or equipment owner.

Section B7: Instrument/Equipment Calibration and Frequency

Field equipment calibration requirements are contained in the *TCEQ Surface Water Quality Monitoring Procedures, Volume I: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012* (RG-415*)*. Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted.

Detailed laboratory calibrations are contained within the QM(s).

GPS receivers cannot be calibrated. However, a number of settings can be changed (maximum position dilution of precision, signal-to-noise ratio, filter coefficient, etc.) which will affect operation of the unit. In general, manufacturer default settings will be employed for optimum data accuracy.

Section B8: Inspection/Acceptance for Supplies and Consumables

No special requirements for acceptance are specified for field sampling supplies and consumables.

Inspection/acceptance for laboratory-related supplies and consumables is specified in the laboratory QM.

Generally however, supplies will be inspected upon receipt for visible signs of damage and purchased from reputable vendors to ensure quality.

For GPS operations, the primary consumables are batteries. During the equipment testing, inspection and maintenance periods, batteries will be examined by the GPS Operator for functionality, charge and compatibility with manufacturer's specifications. Fully charged, backup batteries will be taken to the field for use when recharging is not an option.

Section B9: Non-direct Measurements/Secondary Data Use

USGS gage station data will be used throughout this project to aid in determining gage height and flow. Rigorous QA checks are completed on gage data by the USGS and the data is approved by the USGS and permanently stored at the USGS. This data will be submitted under parameter code 00061 Flow, Instantaneous or parameter code 74069 Flow Estimate depending on the proximity of the monitoring station to the USGS gage station.

Historical data collected by TCEQ and Clean Rivers Program partners (LCRA) under approved QAPPs and included in SWQMIS will also be used to help in assessment of the watershed. Historical data will be used to assess and characterize trends and variability in water quality as described in Subtask 5.6. Historical data includes: 1) ambient water quality data (including groundwater), 2) stream flow and water level data, 3) precipitation record, and 4) biological data.

Section B10: Data Management

It is imperative that data and associated applications be maintained and managed in a manner consistent with the development and use of the data; in this case, data will be maintained so that they are consistent with project requirements. For scientifically valid results, the data, program applications, and reports must be handled in an orderly and consistent manner. Documented quality assurance and quality control checks/procedures are applied to all received data sets, individual data points and data manipulation programs.

Field Collection and Management of Samples

All field collection will be completed as described in Section B2 of the QAPP. A COC is filled out for each sampling event noting the site name, time and date of collection, sample type, comments, sample collector's name, and other pertinent data. Samples collected will be labeled with site identification, date, sampler's initials, and time of sampling and transported to the laboratory as outlined in B3. Finally, the COC and accompanying sample bags/bottles are submitted to EARDC, with relinquishing and receiving personnel both signing and dating the COC.

GPS Data

GPS equipment will be used to map eroding streambanks and invasive species, as well as a component of the information required by the Station Location (SLOC) request process for creating the certified positional data that will ultimately be entered into the TCEQ SWQMIS database. Positional data obtained by the TTU-LRFS using a GPS will follow the TCEQ's OPP 8.11 and 8.12 policy regarding the collection and management of positional data. All positional data will be collected by a GPS certified individual with an approved GPS device to ensure that positional data are reliable and accurate.

In lieu of entering certified GPS coordinates, positional data may be acquired with a GPS and verified with photo interpolation using a certified source, such as Google Earth or Google Maps. The verified coordinates and map interface can then be used to develop a new station location.

Laboratory Data

Once the samples are received at EARDC, samples are logged and stored as described in Table B2.1 until processed. The COC will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. If any discrepancy is found, proper corrections will be made. All COC and analytical data will be manually entered into electronic spreadsheets. The electronic spreadsheets will be created in Microsoft Excel software on an IBM-compatible microcomputer with a Windows Operating System. The spreadsheets will be maintained on the computer's hard drive, which is also simultaneously saved in a network folder. Data manually entered in the spreadsheets will be reviewed for accuracy by the Project Co-Leads to ensure that there are no transcription errors. The EARDC Lab Manager will monitor and evaluate data for all lab analyses. Paper and electronic copies of data will be housed in EARDC for a period of two years following the conclusion of the project. Any COC's and analysis records related to QA/QC of lab procedures will be housed at EARDC. All pertinent electronic data files will be backed up monthly on an external hard drive and stored in separate area away from the computer. Finally, all electronic files will be archived to CD upon completion of the project, and then stored with the final report for 5 years.

Data Validation and Management

Following review of laboratory data, any data entry that is not representative of environmental conditions, because it was generated through poor field or laboratory practices, will not be submitted to the TSSWCB. This determination will be made by the Project Co-Leads, TWRI QAO, TSSWCB QAO, and other personnel having direct experience with the data collection effort. This coordination is essential for the identification of valid data and the proper evaluation of that data. The validation will include the checks specified in Section D2.

Data will be incorporated into the TTU-LRFS project database and subject to varying levels of review. The QA/QC checks evaluate each data set as a whole, and the validity of individual data points. Each data set to be processed into the database is evaluated for any problems that might impose a limitation on the use of the data. This check is performed prior to processing/importing to the database. The following information is considered:

a. Credibility of data source
b. Acceptable QA/QC procedures
c. Intended use of the data
d. Frequency of data collection/impact of missed sampling events
e. Sample size
f. Sample collection and preservation methods
g. Field and laboratory test procedures
h. General documentation

Upon passing the evaluation of a data set's limitations, the data are incorporated into the TTU-LRFS project database. Initially data are entered, either manually or electronically, into a set of working directory files that are consistent with the TTU-LRFS project database file structures. Any deviation found in the data set will be conveyed to the TWRI Project Lead by TTU-LRFS. Disqualified data will be removed from the dataset and will not be submitted to the TSSWCB for inclusion in SWQMIS. The reason for the data removal will be listed on the data summary.

Electronic data input procedures vary according to the source and format of the data. Manual data input will be made to appropriately structured data tables. Standardized procedures are followed to ensure proper data entry.

After the data/data sets have been input/converted into an appropriate working directory database, the individual data points will be evaluated to determine their reasonableness. Data values that are considered outliers will be discarded or coded prior to entry into the records directory. The criteria for determination of outliers will be based on individual data sets being processed for entry into the TCEQ's SWQMIS database. Once the data set is complete, any individual points falling outside the most recent Max/Min range as defined by the TCEQ SWQM Parameters Table will be considered outliers. If an outlier does occur, then it will be noted in the remark section of the database and verified against the original data report, and if necessary, verified by the laboratory. After verification, outliers will be flagged.

After the final QA checks are performed by TTU-LRFS, data are submitted to the TSSWCB PM. Data are then transferred from the TSSWCB PM to the TCEQ CRP Data Manager, who then loads the data into SWQMIS.

Only data collected under this project and its QAPP will be transferred. The tag series transferred is documented on the Data Summary (Appendix D) that is submitted to the TCEQ upon the completion of the data transfer. All QA data sets associated with the data transfer will be submitted in the form of a QA Table. The files are transferred as pipe delimited text file format as described in the *Surface Water Quality Monitoring Data Management Reference Guide, 2009* or most recent version to the TSSWCB PM. After data have been transferred, reviewed, and loaded into the TCEQ Database, a link will provided to the TCEQ's Surface Water Quality Web Reporting Tool at http://www8.tceq.state.tx.us.SwqmisWeb/public/index.faces for public access.

Record Keeping and Data Storage

A three ring binder will be used as a data set log to track all hard copy data sets associated with the TTU-LRFS project database. The database management log will also record the structure of tables, data modifications and updates, and record of dates for all file revisions.

Complete original electronic data sets are archived. Electronic data are backed up on a daily basis Monday through Friday of each work week and stored at an off-site location to prevent loss due to a disaster. Backed up files are maintained indefinitely. The original hard copies of field data sheets and laboratory reports are stored in binders at the TTU-LRFS for a minimum period of five years.

Information Resource Management Requirements

Data will be managed consistent with the *TCEQ Surface Water Quality Monitoring Data Management Reference Guide*, GIS Policy (TCEQ OPP 8.11), and GIS Policy (TCEQ OPP 8.12). The personnel collecting data for this project do not creat TCEQ certified locational data using GPS equipment. GPS equipment may be used as a component of the information required by the Station Location (SLOC) request process, but TCEQ staff are responsible for creating the certified locational data that will ultimately be entered into the TCEQ SWQMIS. Any information developed for this project using a Geographic Information System (GIS) will be used solely to meet deliverable requirements and will not be submitted to the TCEQ as a certified data set.

Data Errors and Loss

To prevent loss of data and minimize errors, all data generated under this QAPP are verified against the appropriate quality assurance checks as defined in the QAPP, including but not limited to COC procedures, field sampling documentation, laboratory analysis results, and quality control data. The data are also verified by comparing 10% of the data in the database to hard copy reports as a check against transcription errors.

Backup/Disaster Recovery Requirements

All data associated with the project database and network files are completely backed-up daily. The IBM Server PC is protected with battery backup and surge protection to safely work through blackouts and save open network files.

Should the computer system or software fail, TTU-LRFS will request the assistance of a Computer/Network Specialist to evaluate the probable cause of the failure, methods to prevent reoccurrence of the problem, and guide recovery of the system. The archived tape backups will allow for complete recovery of the hard disk drive contents.

Data Dissemination

At the conclusion of the project, the Project Co-Leads will provide a copy of the complete project electronic spreadsheet via recordable CD to the TSSWCB PM, along with the final report. The TSSWCB may elect to take possession of all project records. However, summaries of the data will be presented in the final project report.

Section C1: Assessments and Response Actions

The Table C1.1 presents types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TWRI & TTU-LRFS	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Progress Report
Monitoring Systems Audit of TTU-LRFS	Once per life of project	TSSWCB QAO	Field sampling, handling and measurement; facility review; and data management as they relate to project	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Once per life of project	TSSWCB QAO	Analytical and quality control procedures employed at the laboratory	30 days to respond in writing to the TSSWCB to address corrective actions

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, SWQM Procedures Manual, SOPs, or Data Management Reference Guide. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of the TTU-LRFS Director, in consultation with the TWRI Project Lead and QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the project quarterly progress reports and by completion of a CAR. CARs should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

The status of CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately.

The Project Lead or PM or each respective entity is responsible for implementing and tracking corrective actions. Records of audit findings and corrective actions are maintained by the Project Lead or PM of each respective entity. Audit reports and corrective action documentation will be submitted to the TSSWCB with the quarterly progress report.

Section C2: Reports to Management

Quarterly progress reports will be generated by TWRI personnel and will note activities conducted in connection with the water quality monitoring, items or areas identified as potential problems, and any variation or supplement to the QAPP. CAR forms will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference by all project personnel and at TWRI and disseminated to individuals listed in section A3. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

If the procedures and guidelines established in this QAPP are not successful, corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problem. CARs will be filled out to document the problems and the remedial action taken. Copies of CARs will be included with the project's quarterly reports. These reports will discuss any problems encountered and solutions made. These reports are the responsibility of the QAO and the PM and will be disseminated to individuals listed in section A3.

The final report for this project will be a completed watershed protection plan entitled "Upper Llano River Watershed Protection Plan." This document will be a culmination of the work conducted under this project. Additional technical reports are anticipated. Possible topics include water quality trends, biological assesments (fish, macroinvertebrate, and habitat assessment), and invasive plant distributions. These reports will be included in the WPP as technical appendices or support documents.

Section D1: Data Review, Verification and Validation

All field and laboratory data will be reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported to the TSSWCB.

The procedures for verification and validation of data are described in Section D2, below. TTU-LRFS is responsible for ensuring that field and laboratory data collected are properly reviewed, verified, and submitted in the required format for the project database. TWRI is responsible for validating that all data collected meet the DQOs of the project are suitable for submission to TSSWCB.

Specific review and validation criteria for GPS data are outlined in Table D1.1.

Table D1.1. GPS Data Review, Validation, and Verification Criteria

Data Element	Reviewed By	Validation Criteria
Coordinate Data	TTU-LRFS	Consistent with Sampling Process Design
Coordinate Data	GPS Operator	GPS Mode Matches Field Log & GPS Internal Data
Coordinate Data	GPS Operator	Default Settings Match GPS Internal Data
Coordinate Data	GPS Operator	Standard Deviation below 3 Meters for Acceptance
Coordinate Data	GPS Operator	Good Fit when Data Plotted against Known Locations
Coordinate Data	GPS Operator	Meets National Map Accuracy Standards

Section D2: Verification and Validation Methods

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staffs are listed in the first two columns of Table D2.1, respectively. Potential errors are identified by examination of documentation and by manual *(or computer-assisted)* examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with the higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected and not reported to the TSSWCB for submission to TCEQ for storage in SWQMIS. Field and laboratory reviews, verifications, and validations are documented.

Table D2.1. Data Review Tasks

Data to be Verified	TTU-LRFS	EARDC	TWRI
Sample documentation complete; samples labeled, sites identified	D		
Field QC samples collected for all analytes as prescribed in QAPP	D		
Standards and reagents traceable		LM	
Chain of custody complete/acceptable	D	LM	
NELAP Accreditation is current		LM	
Sample preservation and handling acceptable		LM	
Holding times not exceeded		LM	
Collection, preparation, and analysis consistent with QAPP	D	LM	PM
Field documentation (e.g., biological, stream habitat) complete	D		
Instrument calibration data complete	D	LM	
Bacteriological records complete	D	LM	
QC samples analyzed at required frequency		LM	
QC results meet performance and program specifications		LM	
Results, calculations, transcriptions checked		LM	
Laboratory bench-level review performed		LM	
All laboratory samples analyzed for all scheduled parameters		LM	
Nonconforming activities documented	D	LM	PM
Outliers confirmed & documented; reasonableness checked	D	LM	PM
Data properly formatted for SWQMIS & checked for errors	D		PM

D: Director LM: Lab Manager PM: Project Manager

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step as specified in Table D2.1 is performed by the

TTU-LRFS Director and QAO. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

The Data Review Checklist (See Appendix D) covers three main types of review: data format and structure, data quality review, and documentation review. The Data Review Checklist is transferred with the water quality data submitted to the TSSWCB to ensure that the review process is being performed.

GPS Data

GPS coordinate data collected will be verified and validated as described in Table D2.2.

Table D2.2. GPS Coordinate Data Verification and Validation Methods

Data Element	Validation Method
Coordinate Data	Compare Sampling Process vs. Field Log and Internal GPS Log
Coordinate Data	Compare GPS Planned Mode vs. Field Log and Internal GPS Log
Coordinate Data	Compare Manufacturer Default Settings vs. Internal GPS Log
Coordinate Data	95% of Coordinate Points fall within National Map Accuracy Standards when overlaid on known quality map features of similar accuracy

The final element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the TTU-LRFS Director validates that the data meet the data quality objectives of the project and are suitable for reporting to TSSWCB and subsequently TCEQ.

If any requirements or specifications of the QAPP are not met, based on any part of the data review, the responsible party should document the nonconforming activities and submit the information to the TTU-LRFS Director with the data. This information is communicated to the TSSWCB by the TTU-LRFS in the Data Summary (See Appendix D).

Section D3: Reconciliation with User Requirements

Data produced in this project, and data collected by project personnel will be analyzed and reconciled with project data quality requirements set forth in this QAPP. Data meeting project requirements will be used in the development of the Upper Llano River WPP and will also be submitted to TCEQ for assessment purposes and use in the development of the biennial *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* in accordance with TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data*. Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

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APPENDIX A

Corrective Action Report

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Corrective Action Report
SOP-QA-001
CAR #:______________

Date:_____________________ Area/Location:______________________

Reported by:_____________________ Activity:____________________________

State the nature of the problem, nonconformance or out-of-control situation:
____
____
____
____

Possible causes:
____
____
____

Recommended Corrective Actions:
____
____
____

CAR routed to:_________________________________
Received by:___________________________________

Corrective Actions taken:
____
____
____
____

Has problem been corrected?: YES NO

Immediate Supervisor:________________________________

Program Manager:____________________________________

TWRI Quality Assurance Officer:______________________________

TSSWCB Quality Assurance Officer:_____________________________

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APPENDIX B

Field Data Sheets

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Surface Water Quality Monitoring
Field Data Sheet

Llano River Field Station - Texas Tech University
PO Box 186
Junction, TX 76849
(325) 446-2301

Sample Location:

Station ID: **Date Collected**:

Sample Matrix: Water / Fecal **Time Collected**:

Collector(s) Name/Signature:

Sample Type: Routine /Storm **Sample Depth**:

Field Tests and Measurements:				**Parameters Collected:**		
	pH (standard units)	00400		E. coli (IDEXX)		Total N
	Water temperature (°C)	00010		E. coli (mTEC)		NNN
	Dissolved oxygen (mg/L)	00300		TSS		Total P
	Specific conductance (µs/cm)	00094		Diss. Ortho-P		
	Instant. Stream Flow (cfs)	00061		Ammonia-N		Field Split
Field Observations						
	01351- Flow severity (1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry)					
	89835- Flow measurement method (1-gage, 2-electric, 3-mechanical, 4-weir/flume, 5-doppler)					
	72053- Days since last significant rainfall					
	89966- Present weather (1-clear, 2-partly cloudy, 3-cloudy, 4-rain, 5-other)					
	74069- Stream flow estimate (cfs) *Required measurements to calculate flow estimates					
	Stream width (ft)*				Note: Instantaneous stream flow is preferable to a stream flow estimate	
	Average depth of stream (ft)*					
	Distance object travels (ft)*					
	Time for object to travel distance (seconds)*					
Comments:						

Discharge Measurement Field Worksheet Worksheet

Sample Location:

Station ID: **Date Collected**:

File Name: **Time Collected**:

Collector(s) Name/Signature:

Distance (ft)	Depth (ft)	Velocity (ft/s)	Area (ft^2)	Flow (cfs)

Estimated flow _____________cfs

Comments/Observations:

Stream Physical Characteristics Worksheet

Sample Location:	**Station ID**:
Date Collected:	**Time Collected**:
Weather conditions:	
Collector(s) Name/Signature:	

Observed stream uses:			
Stream type (circle)	Perennial or intermittent with perennial pools		
Sream bends	No. well defined	No. moderately defined	No. poorly defined
Aesthetics (circle)	(1) Wilderness (2) Natural (3) Common (4) Offensive		
Land develp. impact	(1) Unimpacted (2) Low (3) Moderate (4) High		
Channel obstructions of modifications			**No. of riffles**
Channel flow status (circle)	High moderate low no flow		
Riparian vegetation (%)	**Left bank**	**Right bank**	**Maximum pool depth**
Trees			
Shurbs			
Grasses or forbs			**Maximum pool width**
Cultivated fields			
Other			
Notes/comments			

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Habitat Assesment Transect Information

Site Name	***Observers***					
Date	***Weather Conditions***					
Location						
	T1	**T2**	**T3**	**T4**	**T5**	**T6**
Stream type (RI=riffle, RU=run, G=glide, P=pool)						
Stream width						
Left bank slope						
% left bank erosion						
Left bank width of natural buffer						
Right bank slope						
% right bank erosion						
Right bank width of naural buffer vegetation						
% tree canopy						
Dominant substrate (1=cly, 2=silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other)						
% substrate gravel or larger						
% instream cover						
Number of instream cover types						

Habitat Assesment Transect Information (cont.)

Site Name	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Stream depth at point 1						
Stream depth at point 2						
Stream depth at point 3						
Stream depth at point 4						
Stream depth at point 5						
Stream depth at point 6						
Stream depth at point 7						
Stream depth at point 8						
Stream depth at point 9						
Stream depth at point 10						
Stream depth at point 11						
Thalweg depth						

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APPENDIX C

Chain of Custody Record

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TEXAS STATE
EDWARDS AQUIFER RESEARCH AND DATA CENTER LABORATORY
248 Freeman Bldg
San Marcos, Texas 78666-4616
A member of The Texas State University System

Telephone: 512/245-2329
FAX: 512/245-2669
E-mail: jg13@txstate.edu

CHAIN-OF-CUSTODY & ANALYSIS REQUEST

Client//Project Name:				Sampler: (signature)			
Field Sample ID	Start Date/Time	End Date/Time	Sample Type (Grab/ Comp.)	Sample Description (Drinking Water or Non-Potable)	Analysis, Containers and Sample Preservation	Sample Temp. (^oC) CF= ^oC	Lab ID#

Relinquished by: (print & sign)	Date	Received by: (print & sign)	Date	Time
Relinquished by: (print & sign)	Date	Received by: (print & sign)	Date	Time
Relinquished by: (print & sign)	Date	Received by: (print & sign)	Date	Time
Relinquished by: (print & sign)	Date	Received for EARDC Laboratory: (print & sign)	Date	Time
Sample Disposal Method:	Disposed of by: (signature)		Date	Time

CODES P-Plastic L-Liter G-Glass mL-Milliliters H_2SO_4-Sulfuric Acid HNO_3-Nitric Acid HCI-Hydrochloric Acid	Client Address and Phone #: *(Required)*	Temp. taken with ________ Cooling process has begun ____ (Y/N)	General Comments: Sample to be subcontracted ❑ Yes ❑ No

FORM: 002COC REV. 2012

CF = correction factor ^oC = degrees centigrade Y = Yes N = No

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APPENDIX D

Data Review Checklist
and
Data Summary Sheet

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Data Review Checklist

Title of associated QAPP: ____

			√, X, or N/A
Data Format and Structure			
A.	Are there any duplicate *Tag ID* numbers?		______
B.	Are the *Tag prefixes* correct?		______
C.	Are all *Tag ID* numbers 7 characters?		______
D.	Are TCEQ station location (SLOC) numbers assigned?		______
E.	Are sampling *Dates* in the correct format, MM/DD/YYYY?		______
F.	Is the sampling *Time* based on the 24-hour clock (e.g. 13:04)?		______
G.	Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality) and any punctuation deleted?		______
H.	*Source Code 1, 2* and *Program Code* are valid and used correctly?		______
I.	Is the sampling date in the *Results* file the same as the one in the *Events* file?		______
J.	Values represented by a valid parameter (*STORET*) code with the correct units and leading zeros?		______
K.	Are there any duplicate parameter codes for the same *Tag Id*?		______
L.	Are there any invalid symbols in the Greater Than/Less Than (*GT/LT*) field?		______
M.	Are there any tag numbers in the *Results* file that are not in the *Events* file?		______
N.	Have confirmed outliers been identified? (with a ■1" in the Verify_flg field)		______
O.	Have grab data (bacteria, for example) taken during 24-hr events been reported separately as RT samples?		______
P.	Is the file in the correct format (ASCII pipe-delimited text)?		______
Data Quality Review			
A.	Are all the values reported at or below the AWRL?		______
B.	Have the outliers been verified?		______
C.	Checks on correctness of analysis or data reasonableness performed?		
	e.g.:	Is ortho-phosphorus less than total phosphorus? Are dissolved metal concentrations less than or equal to total metals?	______
D.	Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets?		______
E.	Are all parameter codes in the data set listed in the QAPP?		______
F.	Are all stations in the data set listed in the QAPP?		______
Documentation Review			
A.	Are blank results acceptable as specified in the QAPP?		______
B.	Were control charts used to determine the acceptability of field duplicates?		______
C.	Was documentation of any unusual occurrences that may affect water quality included in the Event file Comments field?		______
D.	Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain on next page.		______
E.	Were there any failures in field and laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain on next page.		______

√ = Yes **X = No** **N/A** = Not applicable

Describe any data reporting inconsistencies with AWRL specifications. Explain failures in sampling methods and field and laboratory measurement systems that resulted in data that could not be reported to the TCEQ. (attach another page if necessary):

____

____

____

____

____

Date Submitted to TCEQ: ______________________________
Tag ID Series: _______________________________________
Date Range: ____
Data Source: ____
Comments (attach README.TXT file if applicable):

____

____

____

____

Planning Agency's Data Manager Signature: ____________________________________

Date: ____________________________________

DATA SUMMARY

Data Set Information

Data Source: ____.

Date Submitted: ____.

Tag_id Range: ____.

Date Range: ____.

Comments:

Please explain in the space below any data discrepancies discovered during data review including:

- Inconsistencies with AWRL specifications or LOQs
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ (indicate items for which the Corrective Action Process has been initiated).
- Include completed Corrective Action Plans with the applicable Progress Report.

____

____

____

____

____

____

____

____

□ I certify that all data in this data set meets the requirements specified in Texas Water Code Chapter 5, Subchapter R (TWC §5.801 et seq) and Title 30 Texas Administrative Code Chapter 25, Subchapters A & B.

□ This data set has been reviewed using the Data Review Checklist.

Planning Agency Data Manager: ____.

Date: ____.